UNIVERSIDADE DA CORUÑA

| Teaching Guide | | | | |
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| Identifying Data | | | | 2022/23 |
| Subject (*) | Preparation of Nanomaterials | | Code | 610509120 |
| Study programme | Mestrado Universitario en Investigación Química e Química Industrial (Plan 2020) | | | |
| Descriptors | | | | |
| Cycle | Period | Year | Type | Credits |
| Official Master's Degree | 1st four-month period | First | Optional | 3 |
| Language | Galician | | | |
| Teaching method | Face-to-face | | | |
| Prerequisites | | | | |
| Department | Química | | | |
| Coordinador | Señaris Rodriguez, Maria Antonia | E-mail | m.senaris.rodriguez@udc.es | |
| Lecturers | Bermúdez García, Juan Manuel<br>Señaris Rodriguez, Maria Antonia | E-mail | j.bermudez@udc.es<br>m.senaris.rodriguez@udc.es | |
| Web | | | | |
| General description | Introduction to the preparation of nanomaterials, both inorganic and organic nanomaterials. Key factors in the control and shape of nanomaterials. Relationships between shape and size and their properties. Introduction of the main applications of nanomaterials. | | | |

| Study programme competences / results | |
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| Code | Study programme competences / results |
| A3 | Innovate in the methods of synthesis and chemical analysis related to the different areas of chemistry |
| A9 | Promote innovation and entrepreneurship in the chemical industry and in research. |
| B1 | Possess knowledge and understanding to provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context |
| B3 | Students should be able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments. |
| B5 | Students must possess learning skills to allow them to continue studying in a way that will have to be largely self-directed or autonomous. |
| B7 | Identify information from scientific literature by using appropriate channels and integrate such information to raise and contextualize a research topic |
| B8 | Evaluate responsibility in the management of information and knowledge in the field of Industrial Chemistry and Chemical Research |
| B9 | Demonstrate ability to analyze, describe, organize, plan and manage projects |
| B10 | Use of scientific terminology in English to explain the experimental results in the context of the chemical profession |
| C1 | CT1 - Elaborar, escribir e defender publicamente informes de carácter científico e técnico |
| C3 | CT3 - Traballar con autonomía e eficiencia na práctica diaria da investigación ou da actividade profesional. |
| C4 | CT4 - Apreciar o valor da calidade e mellora continua, actuando con rigor, responsabilidade e ética profesional. |

| Learning outcomes | | | |
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| Learning outcomes | Study programme competences / results | | |
| Describe the aspects of physical laws that predominate in the behavior of nanometer-sized systems. | AC9 | BC1<br>BC3<br>BC8<br>BC9 | CC3 |
| Define which construction methods of nanostructures should be chosen based on the desired properties. | AC3 | BC1<br>BC3<br>BC5 | CC1 |
| Describe some methods for the synthesis of nanoparticles. | AC3<br>AC9 | BC7<br>BC10 | CC1<br>CC4 |

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| Describe some methods for surface modification of nanoparticles. | AC3<br>AC9 | BC8<br>BC9<br>BC10 | CC1<br>CC4 |
| Explain the phenomenon of self-assembly, describe the different procedures available to achieve this. | AC3<br>AC9 | BC3<br>BC5<br>BC8 | CC1<br>CC3 |
| Know the current and potential applications of nanotechnology. | AC3<br>AC9 | BC1<br>BC7<br>BC8<br>BC10 | CC1<br>CC4 |

| Contents | |
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| **Topic** | **Sub-topic** |
| Theme 1.Introduction and historical perspective on advanced materials | This first topic will be a historical introduction on the development of nanomaterials. A classification of the materials will be established, as well as a brief description of the fields of activity of the different nanomaterials. |
| Theme 2. Strategies in the search for new materials | This topic will address the different strategies in the synthesis of nanomaterials, with special attention to those that allow us a control in the structure and composition. |
| Theme 3. Nanochemistry and nanomaterials | This topic will introduce the nanomaterials and the main methods of synthesis |
| Theme 4. Inorganic nanomaterials: metal, semiconductors, magnetic oxides | This topic will introduce the main methods of synthesis of nanomaterials with special emphasis on metallic, semiconductors, and magnetic oxides. |
| Theme 5. Organic Nanomaterials: Carbon Nanotubes, Graphene, Polymeric Materials | In this topic we will introduce the main methods of synthesis of nanomaterials with special emphasis on carbon nanotubes, graphene and polymeric materials. |
| Theme 6. Surface modification and hybrid materials | This topic will introduce the main methods of surface modification of nanomaterials. Different hybrid materials will also be introduced. |

| Planning | | | | |
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| **Methodologies / tests** | **Competencies / Results** | **Teaching hours (in-person & virtual)** | **Student?s personal work hours** | **Total hours** |
| Seminar | A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4 | 7 | 21 | 28 |
| Supervised projects | A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4 | 3 | 6 | 9 |
| Mixed objective/subjective test | A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4 | 2 | 0 | 2 |
| Guest lecture / keynote speech | A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4 | 12 | 24 | 36 |
| Personalized attention | | 0 | | 0 |
| **(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.** | | | | |

| Methodologies | |
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| **Methodologies** | **Description** |
| Seminar | Seminars carried out with their own teaching staff, or with invited professionals from the business sector, administration or other universities. Interactive sessions related to different subjects with discussions and exchange of opinions with students |
| Supervised projects | Work in small groups that will have the purpose of studying a topic, a case, etc. Through the discussion among the members of the group. |
| Mixed objective/subjective test | Proof that will be made in the calendar agreed by the Faculty Board. Its objective is to contribute to the evaluation of the knowledge and skills acquired by the students and the ability to relate to this and to obtain an overview of the subject. |

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| Guest lecture / keynote speech | In the master session the contents of the corresponding topics will be introduced, highlighting their most important aspects and stopping particularly in the fundamental concepts and / or more difficult to understand for the students. |

| Personalized attention | |
|---|---|
| **Methodologies** | **Description** |
| Seminar | The teaching methodology proposed is based on the work of the student, who becomes the main responsible for its educational process. |

| Assessment | | | |
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| **Methodologies** | **Competencies / Results** | **Description** | **Qualification** |
| Seminar | A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4 | Valoraranse tanto as respostas dos alumnos como a súa participación nas correspondentes actividades presenciais. Ocasionalmente e a requirimento do profesorado, o alumnado deberá entregar os boletíns de problemas que tamén poderán ser avaliados. | 20 |
| Supervised projects | A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4 | Valoraranse tanto as respostas dos alumnos como a súa participación nas correspondentes actividades presenciais. Ocasionalmente e a requirimento do profesorado, o alumnado deberá entregar informes que tamén poderán ser avaliados. | 25 |
| Mixed objective/subjective test | A3 A9 B1 B3 B5 B7 B8 B9 B10 C1 C3 C4 | Consistirá nunha proba de conxunto que se celebrará ó final do cuadrimestre. Poderá constar tanto de preguntas de desenvolvemento, como de preguntas curtas ou de tipo test e de problemas que serán semellantes ós realizados ó longo do curso. | 55 |

| Assessment comments |
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| General considerations:<br>-It is very important to attend all classes.<br>-It is essential to consult the bibliography and try to complete with advanced aspects the most fundamental concepts that are explained in the class.<br>-The evaluation of this subject will be done through continuous assessment and the completion of a final exam.<br>-The continuous evaluation will have a weight of 45% in the grade of the subject. The rest will be assigned to the final exam result.<br>Recommendations for evaluation<br>The student should review the theoretical concepts introduced in the different topics using the support material provided by the teaching staff and the bibliography recommended for each topic. The degree of accuracy in the resolution of the proposed exercises provides a measure of the student's preparation to face the final exam of the subject. Those students who find important difficulties in working the proposed activities should consult the teacher, in order that the teacher can analyze the problem and help solve those difficulties. |

| Sources of information | |
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| **Basic** | - G. A. Ozin (2008). Nanochemistry: A Chemical Approach to Nanomaterials. Royal Society of Chemistry<br>- D. Vollath (2013). Nanomaterials: an introduction to synthesis, properties and applications. Wiley-VCH<br>- Kenneth J. Klabunde (2009). Nanoscale materials in chemistry. Wiley-Interscience, |

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| Complementary | - A.R. West (2014). Solid State Chemistry and its Applications. Wiley-VCH<br>- C. N. R. Rao, Chintamani Nagesa Ramachandra Rao (1997). New Directions in Solid State Chemistry. Cambridge University Press<br>- U. Schubert, N. Hüsing (2004). Synthesis of Inorganic Materials. Wiley-VCH<br>- K. T. Ramesh (2009). Nanomaterials: Mechanics and Mechanisms. Springer-Verlag<br>- C.N. R. Rao and B. Raveau (1998). Transition metal oxides. John Wiley & Sons |

| Recommendations |
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| Subjects that it is recommended to have taken before |
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| Subjects that are recommended to be taken simultaneously |
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| Subjects that continue the syllabus |
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| Other comments |
| The knowledge required for the completion of the master and those acquired in module 1. |

**(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.**